Just how homogeneous are negative index composites?

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In spite of considerable theoretical efforts, the behavior of negative index composites remains difficult to predict accurately. This has resulted in a shift toward black box phenomenological characterization techniques such as the ubiquitous parameter extraction. To see whether a given structure is a good effective medium, one must do either the experiment, or the tedious full three dimensional simulations.

We put forward [1] a new analytical approach that may allow workers to estimate the usefulness of a given structure before embarking on time consuming experimental or numerical studies. First, each row of wires and each plane of resonators is (analytically) homogenized as a negative ε or μ slab, respectively; second, the resulting slab stack is homogenized to obtain the final effective medium parameters.

The intermediate step, the slab stack, can then be compared with the effective medium to estimate the usefulness of the structure. It can be seen as an *upper bound*, in a sense, on the homogeneity of the composite.

[1] A.I. Căbuz, D. Felbacq and D. Cassagne. *Phys. Rev. Lett*, to be published, (2007).